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Assessment of the Impact of Intellectual Capital on the Profitability of IT Companies in Russia

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Abstract. The aim of the study is a quantitative assessment of changes in the indicators of the effectiveness of Russian IT companies measured by the return on assets depending on changes in intellectual capital (IC) and its specific elements. The research was based on the method of econometric (regression) analysis and bibliographic analysis of similar studies. The study sample consisted of 323 Russian companies operating in information technology. The study's originality is determined by analysing the relationship between intellectual capital and the performance of IT enterprises in an emerging market using the methodology of a modified intellectual value-added coefficient and in the context of individual elements of intellectual capital. A hypothesis of the study is that intellectual capital positively impacts the profitability of Russian companies' assets in the information technology field. According to the results of the analysis, it was confirmed for structural (SCE), human (HCE) and used (CEE) capital. The efficiency of using relational capital has a negative relationship. Results obtained during the analysis consistent with results of other researchers. Our research has practical applications in enterprise human resource management in the computer technology industry.

Keywords: Company performance; Human capital efficiency; Information technology sector; Intellectual capital; ROA

1. Introduction

The world has changed significantly in recent years. All the processes around us are going through the stage of digitalization. The knowledge-intensive economy is focused on obtaining information and knowledge. In the era of globalization, intellectual capital becomes more critical for value creation than physical assets (Weqar et al., 2020). Intangible assets such as employee skills (human capital), technological innovation (structural capital), and customer relationships (direct relational capital) are forms of potential intellectual capital (Rajabalizadeh & Oradi, 2022; Jayabalan et al., 2022; Koroleva et al., 2020). Intellectual capital is increasingly recognized as a strategic asset, although it is not explicitly reflected in financial statements (Qomariah & Nursaid, 2021). It is considered an essential element for a company to increase value and sustain competitiveness (Suseno et al., 2019; Tantra 2018; Zéghal & Maaloul, 2010). The transition from analog to digital technologies and its implementation in almost all industries around the world reflects the importance of the functioning of IT companies (Baranauskas & Raišienė, 2022).

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The development of the digital sector will predetermine the efficient operation of other sectors of the economy, especially in the digitalization of business processes. Products in the IT field have led to significant organisational changes (Kraus et al., 2022). They focus on changes that affect corporate culture, effective management and flexible communications.

While intellectual capital is a significant contributor to development in developed countries, it is still in its infancy in developing countries (Barkat et al., 2018). In Russia, similar studies were conducted, partially addressing the topic of the influence of intellectual capital on the efficiency of small innovative enterprises in high-tech clusters (Ustinova & Ustinov, 2014). There is also interest on the part of researchers in other factors that influence the development of specific sectors of the market of innovative technologies in Russia, such as financing conditions and sources of investment (Kostin et al., 2022; Zaytsev et al., 2020). However, a comprehensive analysis of the relationship between intellectual capital and the efficiency of IT companies on the scale of the entire Russian market has not been carried out before.

Products and services of IT companies are used for digital transformation of production chains, business models and business processes. Its importance has also been highlighted by the global COVID-19 pandemic that started in China at the end of 2019. Within months of its launch, many Russian companies took swift action to change their business models, sales channels, and customer service. The pandemic has demonstrated that companies must use innovative solutions in today's economy (Tutak & Brodny, 2022). A skilled workforce could be an essential factor in the future growth of this industry. The development of this sector of the economy will provide more employment opportunities. Another determining factor is the need to accelerate the innovation cycle since this market is highly competitive and, in a rapidly changing external environment, must quickly respond to changes and new demands from society (Fernández-Portillo et al., 2022; Levstek et al., 2022).

Thus, it was evident that the study of the influence of intellectual capital on the efficiency of Russian companies in the field of information technology is relevant. Foreign authors have already conducted a similar analysis of the relationship between intellectual capital and the efficiency of companies in different sectors of the economy in several countries.

Profit, profitability, various market indicators and profitability were used as performance indicators in the works (Qomariah & Nursaid, 2021; Ge & Xu, 2021; Nadeem et al., 2018; Pucci et al., 2015). Also, most scientists argued that intellectual capital is a combination of structural capital, human capital and natural relational capital, and in the works, they considered the influence of both its components HCE, SCE, CEE (Momani et al., 2021; Oppong & Pattanayak, 2019; Sardo et al., 2018), and complex indicators such as MVIAC (Jin & Xu, 2022). Previous researchers built regression models to explore the impact of intellectual capital. Many scientists agreed that the complex indicator of intellectual capital has a significant impact on profit, productivity and profitability (Ge & Xu, 2021; Nadeem et al., 2018; Sardo et al., 2018; Pucci et al., 2015), a weak one - on sales growth and is not a factor in the development of market indicators (Ge & Xu, 2021). Taking into account previous studies, we take the return on assets as the resulting indicator reflecting the company's performance and put forward the following hypothesis:

H1: Intellectual capital has a positive impact on the return on assets of Russian companies in the field of information technology

This study aims to explore the impact of the individual components of intellectual capital on firm performance.

2. Data and Research Methodology

2.1. Dataset

The study sample consisted of 323 Russian companies operating in the field of information technology in Russia from 2016 to 2020. The affiliation of companies to the area of information technology was determined based on of their chosen core activity. In particular, companies that indicated "Development of computer software, consulting services in this field and other related services" as the main economic activity were selected. In the sampling, companies with abnormally high or low values of critical indicators, bankrupt companies, and companies with a negative balance were excluded. Also, the sample included only companies with a positive return on assets.

2.2. Description of variables

The variables for analysis were selected based on the results of a literature review that looked at the study by Ge and Xu (2021), Oppong and Pattanayak (2019), Nadeem et al. (2018). So, return on assets (ROA) was chosen as an endogenous variable. This indicator reflects corporate profitability, namely, the efficiency of using assets. Below is the calculation formula:

$$ROA_{ct} = \frac{NP_{ct}}{ATA_{ct}} \quad (1)$$

ROA_{ct}– return on company assets c in year t,
NP_{ct}- net profit of the company c in year t,
ATA_{ct}– arithmetic mean of the total assets of the company c in year t.

The exogenous variables in the models are indicators reflecting the effectiveness of the use of individual elements of intellectual capital - structural (SCE), human (HCE), used (CEE) and direct relational capital (RCE). Also, two control variables were included in the model - total assets (TotalAssets), which assesses the company's size, and financial leverage (LEV). Formulas for calculation are presented below:

$$HCE_{ct} = \frac{VA_{ct}}{HC_{ct}} \quad (2)$$

$$SCE_{ct} = \frac{VA_{ct} - HC_{ct}}{VA_{ct}} \quad (3)$$

$$CEE_{ct} = \frac{VA_{ct}}{CE_{ct}} \quad (4)$$

$$RCE_{ct} = \frac{RC_{ct}}{VA_{ct}} \quad (5)$$

$$LEV_{ct} = \frac{TL_{ct}}{TA_{ct}} \quad (6)$$

$$VA_{ct} = S_{ct} - CGS_{ct} \quad (7)$$

VA_{ct}– value added of company c in year t,
HC_{ct}– salary of companyc in year t,
CE_{ct}– the amount of assets of company c in year t,
RC_{ct}– selling expenses of companyc in year t,
TL_{ct}– total liabilities of companyc in year t,
TA_{ct}– total assets of companyc in year t,
S_{ct}- revenue of companyc in year t,
CGS_{ct}- the cost of sales of company c in year t.

Thus, the indicators presented in Table 1 were selected as the studied variables.

Table 1 Description of variables

Notation	Unit of measurement	Explanations
		y
ROA_{ct}	unit	return on assets of company $c$in year$t$
		x
$lnTA_{ct}$	Unit	natural logarithm of the company's total company assets $c$in year$t$
LEV_{ct}	Share	company's financial leverage $c$in year$t$
HCE_{ct}	Coefficient	company labor efficiency $c$in year$t$
SCE_{ct}	Coefficient	efficient use of the company's structural capital $c$in year$t$
CEE_{ct}	Coefficient	the efficiency of the company's capital employed $c$in year$t$
RCE_{ct}	Coefficient	efficient use of direct relational capital of the company $c$in year$t$

2.3. Description of models

We evaluated three regression models: pooled regression model, random effects model and fixed effects model. Annual fixed products are used to control externalities not included in the model that could impact the company. Including these variables in the model will allow us to estimate how much higher or lower the value of the dependent variable is in the study year concerning the base year. Also, to determine the type of panel effects inherent in the models under study, models with fixed and random panel effects are built and compared with each other. The random effects model assumes that individual outcomes are random and follow a normal distribution, while the fixed effects model reflects all individual-level fixed results. The choice between fixed and random effects models is based on the Hausman test. We estimated pooled regression using an ordinary least – squares estimator, random effects model using general least squares estimator and a fixed effects model using a within estimator. A description of the models is presented in Table 2.

Table 2 Description of models

Model designation	Mathematical equation
M1.1: pooled regression model	$ROA_{ct} = \alpha \boldsymbol{i_N} + \beta_1 lnTA_{ct} + \beta_2 LEV_{ct} + \beta_3 HCE_{ct} + \beta_4 SCE_{ct} + \beta_5 CEE_{ct} + \beta_6 RCE_{ct} + \boldsymbol{\varepsilon_t}$
M1.2: pooled regression model with year fixed effects	$ROA_{ct} = \alpha \boldsymbol{i_N} + \beta_1 lnTA_{ct} + \beta_2 LEV_{ct} + \beta_3 HCE_{ct} + \beta_4 SCE_{ct} + \beta_5 CEE_{ct} + \beta_6 RCE_{ct} + \gamma_k \boldsymbol{Year}_t + \boldsymbol{\varepsilon_t}$
M2.1: panel random effects model	$ROA_{ct} = \alpha \boldsymbol{i_N} + \beta_1 lnTA_{ct} + \beta_2 LEV_{ct} + \beta_3 HCE_{ct} + \beta_4 SCE_{ct} + \beta_5 CEE_{ct} + \beta_6 RCE_{ct} + \boldsymbol{u_t}$ $\boldsymbol{u_t} = \boldsymbol{\mu} + \boldsymbol{\varepsilon_t}$
M2.2: panel random effects model with year fixed effects	$ROA_{ct} = \alpha \boldsymbol{i_N} + \beta_1 lnTA_{ct} + \beta_2 LEV_{ct} + \beta_3 HCE_{ct} + \beta_4 SCE_{ct} + \beta_5 CEE_{ct} + \beta_6 RCE_{ct} + \gamma_k \boldsymbol{Year}_t + \boldsymbol{u_t}$ $\boldsymbol{u_t} = \boldsymbol{\mu} + \boldsymbol{\varepsilon_t}$
M3.1: panel fixed effects model	$ROA_{ct} = \alpha \boldsymbol{i_N} + \beta_1 lnTA_{ct} + \beta_2 LEV_{ct} + \beta_3 HCE_{ct} + \beta_4 SCE_{ct} + \beta_5 CEE_{ct} + \beta_6 RCE_{ct} + \gamma_k \boldsymbol{Year}_t + \boldsymbol{\mu} + \boldsymbol{\varepsilon_t}$
M3.2: panel and year fixed effects model	$ROA_{ct} = \alpha \boldsymbol{i_N} + \beta_1 lnTA_{ct} + \beta_2 LEV_{ct} + \beta_3 HCE_{ct} + \beta_4 SCE_{ct} + \beta_5 CEE_{ct} + \beta_6 RCE_{ct} + \gamma_k \boldsymbol{Year}_t + \boldsymbol{\mu} + \boldsymbol{\varepsilon_t}$

3. Results and Discussion

3.1. Results of descriptive statistics analysis and correlation analysis

The results of descriptive statistics are presented in Table 3. The average return on assets of the companies represented in the sample was 0.218%. Among the indicators of intellectual capital, the highest average value of the indicator HCE_{ct}, is equal to 2.339. This

is consistent with previous findings by Bollen, Vergauwen, and Schnieders, Chowdhury, Rana, and Azim (Chowdhury et al., 2019; Bollen et al., 2005).

Table 3 Descriptive statistics

Variable	N	Mean	Min	Max	Standard Deviation
ROA_{ct}	1,194	0.218	0.000	2.295	0.303
HCE_{ct}	1,054	2.339	0.097	51.895	4.053
SCE_{ct}	1,211	0.018	-9.327	1.000	1.153
CEE_{ct}	1,211	0.764	0.000	8.557	0.765
RCE_{ct}	1,211	0.184	0.000	2.256	0.247
LEV_{ct}	1,211	0.533	0.000	0.999	0.283
$lnTA_{ct}$	1,211	19.456	12.514	28.278	1.768

According to the information in table 4, the results of the correlation analysis show that ROA_{ct} is positively correlated with HCE_{ct}, $SCE_{ct}$and $CEE_{ct}$and negatively correlated with RCE_{ct} at a significance level of 0.01. Also, there is a significant correlation between the independent variables. However, the dispersion inflation factor (VIFs) is less than 10, which indicates that the multicollinearity is insignificant.

Table 4 Correlation analysis

Variables	ROA_{ct}	HCE_{ct}	SCE_{ct}	CEE_{ct}	RCE_{ct}	LEV_{ct}	$lnTA_{ct}$
ROA_{ct}	1.000						
HCE_{ct}	0.185*	1.000					
SCE_{ct}	0.215*	0.347*	1.000				
CEE_{ct}	0.456*	0.076	0.178*	1.000			
RCE_{ct}	-0.138*	0.097*	0.078*	0.007	1.000		
LEV_{ct}	-0.339*	-0.013	-0.099*	-0.154*	0.002	1.000	
$lnTA_{ct}$	-0.148*	0.001	-0.041	-0.350*	-0.007	0.103*	1.000

3.2. Regression analysis results

The results of the assessment of regression models are presented in Table 5. It is worth noting that all estimates of the intellectual capital coefficients in all models turned out to be significant. In addition, regardless of the model type, the signs of the coefficient estimates did not change, which indirectly indicates stability. When comparing models with each other, it was concluded that the M3.2 is the best. This is confirmed by the results of the likelihood-ratio test, which suggests that M3.1 is nested within M3.2. Also, the Houseman test showed that it is necessary to choose fixed effects models. Thus, the results are further interpreted for M6, a model with fixed annual and panel effects.

Labor efficiency (HCE_{ct}) is positively related to the return on assets of Russian IT enterprises. This relationship is positive at a significance level of 0.05. The estimate of the coefficient for the variable is 0.014. Structural capital efficiency (SCE_{ct}) is positively related to the return on assets of Russian IT companies and relationship is positive at a significance level of 0.05. The estimate of the coefficient for the variable is 0.017. The company's capital efficiency (CEE_{ct}) is positively related to the return on assets of Russian enterprises in the IT segment. This relationship is positive at a significance level of 0.05 and the coefficient estimate for the variable is 0.192. Direct relational capital efficiency (RCE_{ct}) is negatively related to the return on assets of Russian IT companies and the relationship is negative at a significance level of 0.05. The estimate of the coefficient for the variable is -0.230. Financial leverage (LEV_{ct}) is negatively related to the return on assets of Russian IT enterprises at a significance level of 0.05. The estimate of the coefficient for the variable is

-0.294. The natural logarithm of total assets ($lnTotal\_Assets_{ct}$)is positively related to the return on assets of Russian IT companies at a significance level of 0.05. The estimate of the coefficient for the variable is 0.060.

Table 5 Results of evaluation of regression models

	M1.1	M1.2	M2.1	M2.2	M3.1	M3.2
Indicators of intellectual capital						
HCE_{ct}	0.009***	0.009***	0.012***	0.011***	0.015***	0.014***
	(-0.002)	(-0.002)	(-0.002)	(-0.002)	(-0.002)	(-0.002)
SCE_{ct}	0.019**	0.020**	0.017**	0.018**	0.017*	0.017*
	(-0.007)	(-0.007)	(-0.006)	(-0.006)	(-0.008)	(-0.008)
CEE_{ct}	0.179***	0.179***	0.174***	0.174***	0.185***	0.192***
	(-0.011	(-0.011)	(-0.013)	(-0.013)	(-0.02)	(-0.02)
RCE_{ct}	-0.190***	-0.188***	-0.213***	-0.208***	-0.245***	-0.230***
	(-0.029)	(-0.029)	(-0.033)	(-0.033)	(-0.047)	(-0.047)
Company characteristics						
LEV_{ct}	-0.272***	-0.272***	-0.269***	-0.276***	-0.259***	-0.294***
	(-0.026)	(-0.026)	(-0.031)	(-0.032)	(-0.048)	(-0.049)
lnTotal_Assets$_{ct}$	0.010*	0.010*	0.017**	0.019**	0.039**	0.060***
	(-0.004)	(-0.004)	(-0.006)	(-0.006)	(-0.012)	(-0.014)
Annual effects (reference year: 2016)						
year=2017		0.000		-0.02		-0.036
		-0.026		-0.019		-0.019
year=2018		-0.022		-0.038*		-0.054**
		-0.025		-0.018		-0.019
year=2019		-0.018		-0.042*		-0.068***
		-0.024		-0.018		-0.019
year=2020		-0.002		-0.03		-0.065**
		-0.024		-0.018		-0.02
Constant						
Constant term	0.047	0.057	-0.099	-0.104	-0.545*	-0.903***
	-0.089	-0.091	-0.121	-0.122	-0.244	-0.266
Model characteristics						
R^2	0.373	0.372				
$R^2_{overall}$			0.373	0.372	0.340	0.298
R^2_{within}			0.263	0.272	0.270	0.284
$R^2_{between}$			0.358	0.356	0.321	0.280
N	1044	1044	1044	1044	1044	1044
Aic	-153.084	-146.986	.	.	-1330.58	-1342.83
Bic	-118.429	-92.527	.	.	-1295.92	-1288.37
Rmse	0.224	0.224	0.154	0.154	0.154	0.153
Random panel effects	-	-	+	+	-	-
Fixed panel effects	-	-	-	-	+	+
Fixed year effects	-	+	-	+	-	+
Standart errors in first parenters: * p<0.05, ** p<0.01, *** p<0.001						

The results of the study confirmed our hypothesis that intellectual capital has a positive impact on the profitability of assets of Russian companies in the field of information technology. This statement is true for its components - structural (SCE_{ct}), human (HCE_{ct}) and used (CEE_{ct}) capital. As in any science-intensive sphere, human resources, expressed in human capital, and the non-physical infrastructure supporting them, in other words, structural capital, are decisive for Russian companies' successful functioning in the information technology field. The same applies to the capital used - the more efficiently it is used, the more profitable the IT company will be. Direct relational equity (RCE_{ct}) showed a negative relationship withROA_{ct}. The revealed fact suggests that financial investments in

optimizing relations with external agents generally do not positively impact the performance indicators of companies in the field of information technology. This makes good economic sense, as we are talking about a market where traditionally supply creates demand, and businesses do not need to invest heavily in marketing campaigns and public relations to achieve significant sales volumes. Another feature confirming the economic feasibility of the result obtained is that in the information services market, which includes the IT sector, the demand for information is not massive, its formation is influenced by non-price factors, which means that commercial expenses are not an essential parameter for achieving high performance indicators.

3.3. Discussion

We see that HCE and SCE are positively associated with ROA. Ge and Xu (2021) found that the CEE and HCE ratios show positive and significant relationships in terms of company profits. Descriptive statistics, which were made in their study by Rufus et al. (2022), confirmed that Human Capital contributes to the outstanding efficiency in general. Intellectual capital, human capital and structural capital significantly and positively correlates with corporate performance in an article by researchers Lv and Han (2015). This indicates a positive impact of human resources on the firm's performance. As mentioned above, two elements of intellectual capital - human and structural- and the efficiency of its use- are the determining factors for the successful functioning of companies involved in knowledge-intensive areas, including the information technology sector. Increasing human and structural capital, mainly by investing in them, is a cost-effective measure to improve the performance of IT companies. Oppong and Pattanayak (2019) found that HCE and SCE had little effect on performance.

CEE is also positively associated with ROA. In Oppong and Pattanayak (2019) study, CEE is the only IC component with a positive and significant coefficient. Nadeem et al. (2018) analysis shows that human capital, structural capital and physical capital are also of great importance.

The financial leverage coefficient in the models has a negative correlation, which is consistent with the results of Ge and Xu (2021). The result obtained is economically justified, since an increase in the share of borrowed funds is associated with an increase in risk for the company, or in other words, the presence of a greater probability of not fulfilling existing obligations and, as a result, the possibility of bankruptcy. In the information market for a company, intangible assets are of great value, not real ones, that is, its business reputation, intellectual property, etc. As a result, its obligations are less secured by tangible assets which means that if the probability of their non-fulfillment increases, the most vulnerable are intangible assets, which rapidly begin to depreciate when the company is in a wrong position. Since intangible assets were the key ones in the formation of the company's market value, their depreciation has the most substantial impact on all performance indicators of its activities. So, an increase in financial leverage, equivalent to a rise in risks for an IT company, leads to a decrease in its efficiency.

4. Conclusions

This study was devoted to analysing the influence of intellectual capital on the performance of Russian companies operating in a strategically important segment of the national information technology economy. Considering the complexity of the valuation of this intangible asset, we adhered to the approach already used in scientific works - the consideration of intellectual capital as a combination of its components - structural, human, used and relational. The analysis showed that a significant positive impact on the return on

assets has the efficiency of the use of structural, used and human capital. In other words, in the field of information technology, human resources and a developed intangible infrastructure that support their functioning, as well as the optimal use of available resources, are of decisive importance for a company. Concerning the effectiveness of the use of relational capital, which is the cost of establishing and maintaining relationships with external agents, including consumers, he showed a negative association with ROA.

To the best of our knowledge, it was the first research, which estimated the relationship between profitability and SCE, HCE, CEE and RCE components of intellectual capital for Russian IT companies. Our hypothesis about the positive impact of intellectual capital on the performance of Russian IT companies has been confirmed. This means that the increase in intellectual capital is a promising direction in the field of information technology to achieve high performance indicators.

As already noted, a company's performance is not limited to profitability indicators, but is also measured by its profitability, sales growth and productivity. Moreover, in our work, only individual elements of intellectual capital were considered, while there are methods for calculating complex indicators that cover all its components at once, for example, MVIAC. We must also consider that the valuation of intangible assets, including intellectual capital, is a complex process in which there are many approaches and methods.

Further research in this direction may be associated with the inclusion of new variables in the models, both evaluating various aspects of the efficiency of the enterprise, and representing new indicators for assessing intellectual capital, as well as creating a new methodology for its calculation. The study of the impact of intellectual capital on the activities of companies in other knowledge-intensive areas can lead to exciting results. It is possible that comparative analysis will lead to identification of industry-specific patterns of intellectual capital.

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